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CURING AND FERMENTATION TROUBLES OF TOBACCO AND THEIR CONTROL

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INTRODUCTION.

Much of the trouble which tobacco growers have experienced during recent years as the result of curing conditions can be avoided. With proper attention to such factors as tightness of the sheds, regulation of the temperature and humidity in the shed by ventilation and close attention to firing *when necessary*, the use of instruments to determine the humidity and temperature instead of relying on the sense of feel and appearance, etc., there is no reason why pole sweat and kindred troubles should not be avoided to a great degree.

CURING TROUBLES.

Shed Burn, Tip Burn or Pole Sweat, and Stem Rot.

A decay or rotting of tobacco which occurs during the curing process is known by any one of these names, the specific one depending usually upon the severity of the attack. Mild cases are usually referred to as **tip burn** or **pole burn,** and where more of the leaf area is affected it is generally called **pole sweat.** In more severe cases where the decay develops later, after the leaf web is cured and the midrib or stem is affected, sometimes sufficiently to cause the leaf to drop, it is known as **stem rot.** One name for the trouble would avoid confusion, and as **pole sweat** is the one generally used in this section it will be adopted in this publication.

Description. — In mild cases of **pole sweat** small dark areas, particularly towards the tip of the leaf, are noticeable. Sometimes these spots are scattered irregularly over the upper third of the leaf. The tissue in the spots has no elasticity, and the texture of the leaf

is much injured for wrapper purposes. In more typical cases of **pole sweat** the spots are run together, and the whole leaf may be affected. Occasionally, also, the stem may be rotted, and in such cases the molds, because of the greater amount of food and water in the stem, make a more luxuriant growth. The progress of the rot is very rapid under conditions which favor it, only a short time being necessary to render an entire shed of tobacco worthless. Even a slight amount of **pole sweat** is sufficient to reduce the value of the crop very greatly.

Causal Organisms. — Unlike some of the other troubles found during curing and fermentation, **pole sweat** cannot be attributed to any single organism, and may, in different seasons, be caused by different ones. Even during the same season in different sections several different organisms have been found to be the cause. It is probable that *almost any species of mold developing on the dead and dying tobacco leaf, followed by the invasion of bacteria in some instances, will cause the trouble if conditions of temperature and humidity are favorable to their development.*

The problem of control, then, becomes one of holding the tobacco in such condition that none of the causal organisms (in this case molds) can develop, although most all of them are widely distributed in nature.

Every grower should know that it is only during periods when there is a normal or relatively high air temperature and an accompanying high relative humidity that this trouble can develop, even though the causal organisms may be present. It should be kept in mind that the spores of the causal organisms are probably always present, either in the shed or on the tobacco brought into it, and that this disease can be controlled only if proper precautions are taken to keep the temperature and humidity in the shed at such a point as will prevent their *rapid* development.

Control. — It can be seen, then, that any attempt to control **pole sweat** by eradication of the molds that cause it would be futile. The only feasible method is to regulate the curing conditions

so that the molds will not become active. It is a matter very closely associated with methods of good curing.

During normal seasons the natural cure of tobacco goes on with a fair degree of success, although even at such times the quality of the cured crop could be improved with more careful attention to the regulation of temperature and humidity. It is in moist, warm weather, lasting for twenty-four hours or more, that the grower if he would avoid **pole sweat** should be particularly careful in the regulation of the temperature and humidity in the shed.

There is little if any danger of **pole sweat** until after tobacco has wilted and begun to yellow. It is only after the leaf cells have started to die in the so-called "second stage" of curing, when the leaf is losing water rapidly, that there is much danger. After the leaf has come to color, and its water content has been greatly reduced, — that is, towards the end of the cure, — there is also little or no opportunity for **pole sweat** to develop.

It has been found that the organisms producing the disease do not develop to any great extent where the temperature is below 60° F.; nor will they develop greatly at temperatures above 95° F.; and, what is more important, they do not develop when the relative humidity is less than 85 per cent. (By relative humidity is meant the ratio of the amount of water vapor in the air at any one time to the amount which can exist in the air at that particular temperature, which is saturation, or 100 per cent.)

From this it is clear that the regulation of humidity is the prime factor in the control of the disease. Of course, when the temperature of the air in the shed is raised, the relative humidity is automatically lowered. For every increase in temperature of 15 to 18 degrees the capacity of the air for holding water vapor is practically doubled.

Since it is impossible to cure tobacco below the minimum temperatures of development of the causal molds, firing must be resorted to when the relative humidity is so high (85 per cent, or above) as to make it advisable to reduce it quickly. It is only necessary to raise

the temperature in the shed from 10° to 15° above that of the outside air to reduce the humidity sufficiently to prevent all **pole sweat,** even in extreme weather. Of course, there must be enough top and bottom ventilation to allow the warm air, carrying a large amount of water, to pass out at the top and be replaced by the cooler, heavier air from the outside. At the same time, there must be good air circulation around and through the different tiers, so that the air in the shed may be uniformly heated. The temperature at the bottom tier should not be taken as a guide to the temperature of the entire shed, but it should be taken at several points, above and below.

If there is insufficient ventilation, or the firing is inadequate to heat all of the air in the shed, or it is applied for too short a time, the humidity is but slightly reduced, and conditions in the shed become even more favorable to **pole sweat;** for under such conditions there is a tendency for the air laden with water vapor to deposit the water when it comes in contact with the colder, stagnant air in the upper part of the shed. Under such conditions **pole sweat** may be looked for in the third tier of the shed. As a rule, however, if the tobacco, whether stalk cured or picked leaves, is hung far enough apart there will be little danger resulting from improper circulation after the tobacco has wilted; provided, of course, that there is proper ventilation.

The only method of firing in common use is by charcoal fires. These should be small and well-tended rather than large and left to take care of themselves. It is best to have small fires under every bent, or at least every two bents, during periods of danger, for with the small fires there is much less chance of damaging the tobacco hanging directly over them. Charcoal is the only fuel that can be successfully used with open fires; coke is unsatisfactory and wood is too smoky.

Some growers place a sheet of metal above the fire to spread the heat so that tobacco over the fire may not be overdried.

It is impossible to state the length of time firing should be carried

on, since this depends entirely upon the length of time weather conditions favorable to **pole sweat** continue.

There is danger of overfiring, especially when the tobacco is in the "sponge" state, that is, just as the cells are beginning to die, for at this stage the tobacco will be scalded by excessively hot, moist air. Under no circumstances should the tobacco be allowed to dry out during the firing to the extent that it becomes brittle or crumbly to the touch. If this happens the curing will stop after the firing, or at least will yield a less desirable product.

While it is possible for a grower to determine very closely when weather conditions are conducive to **pole sweat,** it often happens that his judgment is wrong, and for this reason it is much safer for him to have a hygrometer to aid in determining the relative humidity during the curing season. From time to time these instruments should be standardized, but this is not a difficult operation.

Unfortunately many sheds, particularly the older ones, do not have enough roof ventilation to operate well during extremes of temperature and humidity, and to insure good air circulation. Many also are not tight enough for successful firing, or, at times when actual firing is unnecessary, to exclude either dry or moist air as much as would be desirable. There should in all cases be ample roof and bottom ventilators constructed so as to be easily controlled by the grower.

During curing, and particularly during periods when artificial heat is applied, it should be borne in mind that the day temperature, even in muggy or wet weather, is usually higher than that at night, and that the humidity is as a rule higher during the night. Ventilation should be governed accordingly, and it is at this point that the tightness of the sheds plays an important part. At night the fires should be even more carefully tended than during the day.

Fat Stem.

Description. — A trouble commonly known as **fat stem** is sometimes found in cured tobacco. As its name implies, **fat stem** is distinguished by the large wet and discolored midribs or stems which no amount of curing will permanently dry. When water is added after the stem has been partially dried out, it will immediately become wet and fat again.

This is a physiological trouble, and is not caused by any organism. Sometimes only a few leaves in the shed will be affected, or the condition may only be found in the late harvested tobacco or on the top leaves, which are naturally less ripe when harvested than are the middle and lower leaves, especially with stalk-cut tobacco.

Comparatively little is known of the exact conditions which cause **fat stem.** It is thought, however, to be due in some instances to a freezing of the stem before it has had sufficient time to cure to the point where freezing will not injure it.

Fat stem has also been observed in primed tobacco which has had the stem dried and sealed at the butt in the early stages of the cure. While this does not necessarily prevent the stem giving off water, **fat stem** will result if at the same time the surface layers of the stem lose the power of giving off or absorbing water.

Control. — No remedy is known other than to harvest as early as possible in the case of stalk-cut tobacco. If freezing weather is anticipated, and the crop has lost but little of its contained water, the temperature of the shed should be raised by firing lightly until the danger from freezing is past. When caused by excessive heat and the sealing of the stem, nothing can be done. Care should be taken to avoid any great sudden changes in humidity during the first stage of the cure.

White Vein and Saltpeter.

Description. — **White vein** is occasionally reported by growers or packers. It is not caused by an organism, but results from improper conditions in the curing shed, and is found only in seasons

when tobacco is subjected to a long period of hot dry weather before the stem or veins have had a chance to "come down" slowly and naturally.

In cases of **white vein** the surface cells are found to have been dried out rapidly and consequently quickly killed. Under such conditions there is no opportunity for the spreading of the brown color through them, since this layer of cells is separated (owing to their rapid collapse) from the inner layers, which contain most of the brown coloring matter, by an air space. It is this colorless outer layer, backed by an air space, which gives to the veins their characteristic whitish color. This persists after curing, and the leaf is injured for wrapper purposes. When the tobacco is used for filler, the presence of **white vein** is not a matter of great importance. Sometimes **white vein** may be observed after a shed has been fired strongly for a comparatively long time early in the cure.

Control. — The control is rather difficult, since it requires *raising* the humidity of the air in the shed during the period of hot dry weather. Some recommend that water be sprinkled over the floor of the shed as a means of raising the humidity.

White vein should not be confused with the appearance of salt deposits on the stems and larger veins, known commonly as **saltpeter,** which is also brought about by dry weather and high temperature during the earlier stages of curing. The name **saltpeter** is misleading, since the deposit is usually made up of various salts rather than nitrates alone. As a rule, no injury to the tobacco results.

While this trouble may be more or less frequently found, the occurrence of **white vein** is comparatively rare, and does little damage in this section.

FERMENTATION TROUBLES.

Canker or Black Rot.

Description. — **Canker,** sometimes known as **black rot,** is found either in the bundle or in the cases after being fermented by the "natural" or "forced" sweat. It is only occasionally found in bulk fermentation. If not discovered in the bundle, or if it has not developed there, it usually becomes evident only when the cases are opened after fermentation.

The rot is easily recognized both in the bundle and the case, as the affected portions of the leaves turn dark, almost black, and the least handling of the leaf will cause the rotted portions to fall away. There is also a peculiar odor which is characteristic of the cankered tobacco.

Sometimes the damage is very slight, and only a few spots will be noticed; but occasionally the tobacco in a case will be entirely rotted except for a little around the outside. When found in the bundle the rot is rather moist, but cannot be classified as a wet rot; when found in the case the moisture feature is less prominent, and it is a typical dry rot.

The fungus causing **canker** is found more abundantly in warehouses in which cankered tobacco has been sorted, and, owing to the presence of spores of the fungus, the infection of normal tobacco may be brought about, particularly if tobacco is in the "high case" when packed. While much infection probably takes place in the warehouse, in this section the fungus is often found in the bundle before the tobacco leaves the grower, in which case the infection comes either from the fungus being in the shed or in the soil, and consequently is on the leaves when cured. Cleanliness is a great factor in preventing infection.

Control. — It has been observed that most of the **canker** is found on tobacco with a high per cent of moisture content. As it is necessary for the tobacco to heat during fermentation up to and

above the temperature favorable for the development of **canker,** and as the tobacco will naturally heat up in any case if it has a sufficiently high water content, the logical method of control is to regulate the water content and to reduce it to the lowest possible point consistent with proper handling. With this accomplished, almost any desired fermentation temperature may be used. With Connecticut and Massachusetts tobaccos of the sun-grown type it has been found that **canker** rarely develops in lots having a moisture content of 24 per cent or less; with the shade type **canker** has been known to occur in tobacco having a moisture content of 21 per cent.

In bulk sweating **canker** is seldom found, since the temperatures used generally run up rapidly to a point above 112° to 120° or more, depending upon the type of tobacco in the bulk. Such high temperatures, arrived at in a short space of time, are detrimental to the fungus, which is killed before it can do much damage, even if the tobacco is packed with a slight excess of moisture. When the bulk is turned and the hands shaken there is an appreciable loss of moisture and this tends to further reduce the probability of **canker.**

In any case, only enough moisture should be present in the leaf to insure proper handling without damage. Where tobacco is received in a wet condition, but does not show any indication of **canker,** the bundles should certainly be allowed to dry before being placed in the cases. One lot of tobacco that has a high moisture content is enough to cause the start of **canker** when cased and placed in favorable temperatures. The slowness of the rise in temperature of cased tobacco gives the **canker** an opportunity to develop.

The occurrence of **canker** in the bundle is primarily induced by taking the tobacco down in too "high case," or too much at a time, and then putting it into the bundle with a high moisture content, packing it tight, and making the bundles excessively large. A 40-pound bundle is probably about the proper size.

There has been too great a tendency to pack with a maximum of water to gain weight. **Canker** is very apt to result, especially in

large bundles or in bundles piled several tiers high. Good judgment will indicate the proper amount of moisture where actual moisture determinations are not made, and for the grower these would, perhaps, be impracticable. It is only necessary for the tobacco to handle well. Keep the tobacco as nearly on the dry side as possible, and do not make the bundles too large. Store it in well-ventilated places and in such a manner as to avoid any great weight of tobacco piled together. Care should also be exercised against taking down too much during a damp.

If the grower delivers sound tobacco, with the proper amount of moisture in it, and **canker** subsequently develops during fermentation, the responsibility is the packer's rather than the grower's. Most of the **canker** discovered during the last two years at the time of delivery could have been prevented by close attention to the details of bundling and moisture content. It is, of course, necessary at times to moisten the tobacco when it is too dry to handle well, but some growers are careless as to this; the moisture is unevenly distributed through the leaf, and **canker** develops in local areas where there is too much moisture.

Moldy or Musty Tobacco.

Description. — Sometimes a characteristic musty odor develops in tobacco, and on examination a whitish gray growth on the leaf may be seen, particularly on the veins and midrib. This growth is made up of molds, not necessarily of the same kind in every case. The spores of the molds are probably present on the tobacco prior to casing, and develop afterwards when conditions are favorable. They are most noticeable on tobacco which is cased with a comparatively high moisture content, and which afterwards lies for some time at a *low* temperature without heating. Temperatures below 65° F. are particularly favorable for the development of these molds. As a rule, **must** does not occur in cases where **canker** is present, since the temperatures favorable for the development of the **canker** are too high for the growth of the molds causing **must.**

Control. — The best method for the prevention of growth of these molds is to see that all tobacco is cased with the minimum amounts of water compatible with good handling, and with our tobaccos this should not exceed 20 to 25 per cent, approaching the lower limit as nearly as possible. The temperature should be kept above 80° F. If the moisture is controlled, higher temperatures may be used with safety, although they would be favorable, with an accompanying high moisture content, for the development of **canker.** The mold is sometimes brushed off, but this is of little avail, since the musty odor is almost certain to persist. It is stated that spraying with a 4 per cent solution of acetic acid is helpful. Some packers also use a 20 per cent denatured alcohol or weak formaldehyde solution as a spray before repacking. It is better, however, to prevent the trouble than to try to cure it. Cleanliness in the warehouse should also be observed.

Summary.

Pole sweat, including **stem rot** which is in reality due to the same cause, although sometimes acting at a later date, is the most important of the diseases encountered during the curing period. In order for these troubles to occur there must be a relative humidity above 85 per cent, and temperatures above 60° F. The only satisfactory method of control is the regulation of the humidity in the shed, either by ventilation or by firing. The latter should always be done when warm, rainy, or muggy weather continues for any length of time, particularly when the tobacco has yellowed and the browning has commenced. By raising the temperature in the shed 15 degrees the humidity will be reduced approximately one-half, and the danger from **pole sweat** averted. When conditions are less unfavorable the firing need not be so intense, and it will be necessary only to reduce the humidity below the danger point.

Fat stem, a physiological trouble, sometimes occurs, but the exact conditions favoring its development are not known. It is known to follow freezing of the midrib before it is fully cured. It

sometimes is found in picked tobacco that has had the butts "sealed" by excessively high temperatures early in the cure. Usually the heavier or later harvested tobacco is the most liable to be affected. The only method of control is to get a cure as quickly as possible, at the same time avoiding any sudden changes of temperature during the early stages of the cure.

White vein and **saltpeter** are of little importance. The latter does practically no damage to tobacco, and the former may be controlled by not allowing the relative humidity to drop so low during the occurrence of hot dry weather in the early stages of the cure as to dry and kill the outer layer of cells of the veins too quickly. Sprinkling the floor of the shed has been recommended as a means of controlling the humidity and preventing the trouble.

Canker occurs in the bundle or in the fermentation, and is caused by the fungus **Sterigmatocystis nigra,** which is usually present on the leaves of most tobacco. This trouble can develop only in tobacco having a moisture content of 24 per cent or greater, and at temperatures ranging from 60° to 95° F. Temperatures between these limits are usually found to exist for some little time during the "natural" or "forced" sweat of Havana or Broadleaf tobacco, and with an accompanying high moisture content permit of the development of the fungus. Wet lots of tobacco should never be put in the bundle or in the case for fermentation, but should be dried out until the excess of moisture is removed. Tobacco with a moisture content of 24 per cent will handle very nicely. In fermentation, particularly, the disease is bad, as it is not usually detected until the case is opened for sampling.

Moldy or **musty** tobacco is also sometimes found in case fermentation, and the development of the molds connected with this trouble is also connected with the amount of moisture in the tobacco, and also the temperature. The moisture should be reduced as in the case of canker, and the temperature of the room raised, at least kept above 60° F., as it is only in tobacco which has been stored in a cold place with a high moisture content that this develops. None of the

remedies used to remove the moldy or musty odor are really of much use, as it will persist in cases.

Practically all of the troubles associated with the curing and the fermentation of tobacco can be controlled by careful attention to the control of the humidity and temperature. With the present hit-or-miss methods of natural curing it will be difficult in all cases to get complete control, however. There is no reason why some artificial method of curing should not prove a success with our tobacco.